Bell Work
17-Jan-17

How are group number *and* number of valence electrons related?

Agenda

Lewis Dot Structure – Atoms (recap), Compounds
Steps 1-4

Objective:
You will KNOW how to draw Lewis Structures of simple common compounds and ions

EQ: What am I doing today for my future goals and how can keep on track.

Writing Chemical Formulas and net ionic Equations Semester II Pre Test

Show work on separate sheet of paper, answers of test half sheet.

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except Ag^+, Hg_2^{2+}, *Pb^{2+}
I^-	soluble	except Ag^+, Hg_2^{2+}, Pb^{2+}
SO_4^{2-}	soluble	except Ca^{2+}, Ba^{2+}, Sr^{2+}, Hg^{2+}, Pb^{2+}, Ag^+
CO_3^{2-}	insoluble	except Group IA and NH_4^+
PO_4^{3-}	insoluble	except Group IA and NH_4^+
^-OH	insoluble	except Group IA, *Ca^{2+}, Ba^{2+}, Sr^{2+}
S^{2-}	insoluble	except Group IA, IIA and NH_4^+
Na^+	soluble	none
NH_4^+	soluble	none
K^+	soluble	none

*slightly soluble

1. a. $\underline{1}BaBr_2(aq) + \underline{1}Na_2SO_4(aq) \rightarrow \underline{1}BaSO_4(s) + \underline{2}NaBr(aq)$

b. Sodium Bromide

c. $\underline{1}Ba^{2+}(aq) + \underline{1}SO_4^{2-}(aq) \rightarrow \underline{1}BaSO_4(s)$

2.

a. Iron (III) hydroxide and Sodium Nitrate

b. $Fe(OH)_3(s)$

c. Sodium and Nitrate ions (Na^{2+} and NO_3^-)

3. 10g

4. 335g

Home Work

Bell Work, 18-Jan-17

Using only the periodic table:

A. **List the number of each atom in H_2S**

B. **How many valence electrons (Ve^-) does a Hydrogen have?**

C. **Ve^- Sulfur:**

D. **What is the total number of Ve^- dihydrogen sulfide has?**

Agenda:

Valence electron (Ve^-)

Drawing Lewis structure

Objective: You are going to be able to determine the total number of valance electrons in a molecule and be able to apply the octet rule in drawing Lewis structure

EQ: What am I doing today for my future goals and how can keep on track.

Lewis Structure Overview

https://youtu.be/1ZlnzyHahvo

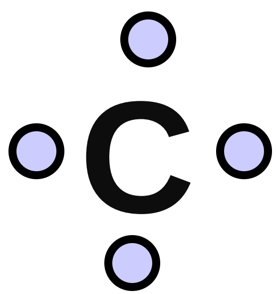
Drawing Lewis Structures

We learned how to draw Lewis Dot structures of ions a few months ago.

To draw a Lewis dot structure of an ion simply draw the elements symbol and then distribute electrons around the symbol.

Take Carbon:

Total # of valence e^- (equals group #): 4



You try: F, O, Mg

You have 30 sec.

Drawing Lewis Structures

Lewis structures are used to identify the types of bonds (single —, double =, triple ≡) formed between atoms in a molecule or polyatomic ion.

Drawing the Lewis structure is not difficult ☺ IF you follow the exact process that I give you.

Now for the steps…

Drawing Lewis Structures

1. Add up the valence electrons from all atoms

H_2O Ve^- :
1 from each H & 6 from O
So 2(1) + 1(6) =8

CO_2 Ve^-:
4 from C & 6 from each O
So 1(4) + 2(6) = 16

You try: SO_2 and SiO_2

SO_2 Ve^- = 1(6) + 2(6) = 18

SiO_2 Ve^- = 1(4) + 2(6) = 16

Drawing Lewis Structures

1. Add up the valence electrons from all atoms
   - For a cation (+), subtract 1 electron for each positive charge
     - NH_4^+ : 1(5) + 4 (1) -1 = 8 Ve^-
   - For an anion (-), add 1 electron for each negative charge
     - CN^- : 1(4) + 1(5) + 1 = 10 Ve^-

You try: NO_2^-, CO_3^{2+}

NO_2^- Ve^- = 1(5) + 2(6) + 1 = 18

CO_3^{2+} Ve^- = 1(4) + 3(6) -2 = 20

Drawing Lewis Structures

2. Draw a skeleton structure showing the chemical symbols for each atom. Connect the appropriate atoms using a single bond –, each line represent 2 e-.

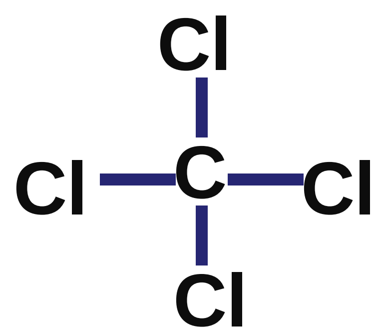
Sometimes (but not always) the order in which the formula is written

HCN: H–C–N

Central atom (written first) surrou

atoms

CCl_4 :



Drawing Lewis Structures

3. Add electron pairs, ,to the atoms bonded to the central atom first until each has an octet (8) of e^-.

Remember, H only gets $2e^-$ so once it bonds it has its $2e^-$.

H—Cl

IF there are any unused e^-, *<u>place all of the leftovers on the central atom</u>*.

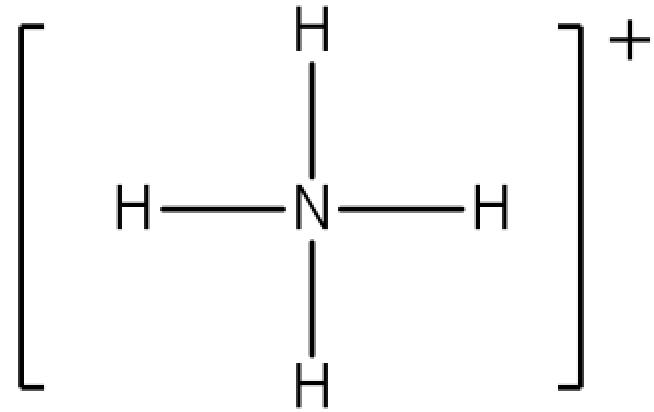
Note: This sometimes gives the central atom more than eight e^-.

Drawing Lewis Structures

4. Do all atoms that need an octet have one? Did you use all of the valance electrons?

If you answered yes then you are done.

Note: if you are drawing an ion (charged particle) the you must put the structure in brackets and label the charge NH_4^+



Practice

Complete the following for Br_2

#of Valence electrons :_____

# of lone pairs (electrons ••):______

#of bonding pairs (—): ______

Structure:

Br Br

Drawing Lewis Structures

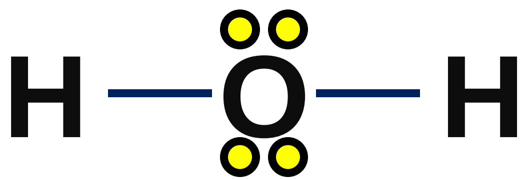
- Lets try one: H_2O

Number of Ve^- : $2(1) + 1(6) = 8e^-$

$-4e^-$

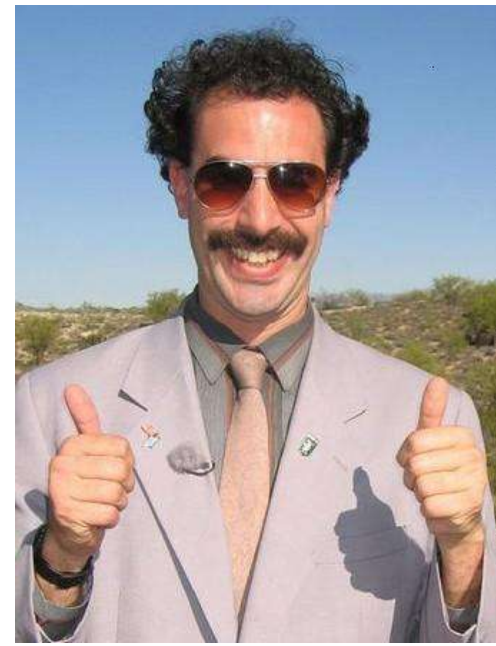
$-4e^-$

0



Did we use all the Ve^-?

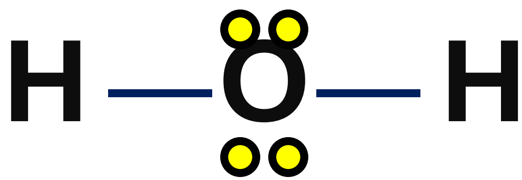
Do all the atoms that need an octet have one?



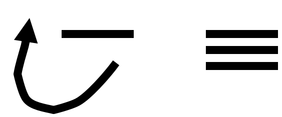
Yesss, you have done good job!!!

Drawing Lewis Structures

H_2O



We have
2 lone e- pairs
2 bonding pairs



Drawing Lewis Structures

- **If <u>(and only if)</u> there are not enough e^- to give the central atom an octet, try multiple bonds.**

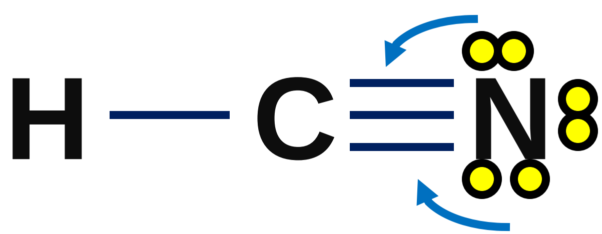
Use one (or more) unshared pairs of e^- to form double (or triple) bonds: HCN

Number of Ve^- : 1+ 4 + 5 = 10Ve^-

$-4e^-$

$-6e^-$

$-0Ve^-$



Now both nitrogen and carbon have an octet

Oops Carbon does not have an octet…

Drawing Lewis Structures

Example: Draw the Lewis structure for $CHCl_3$

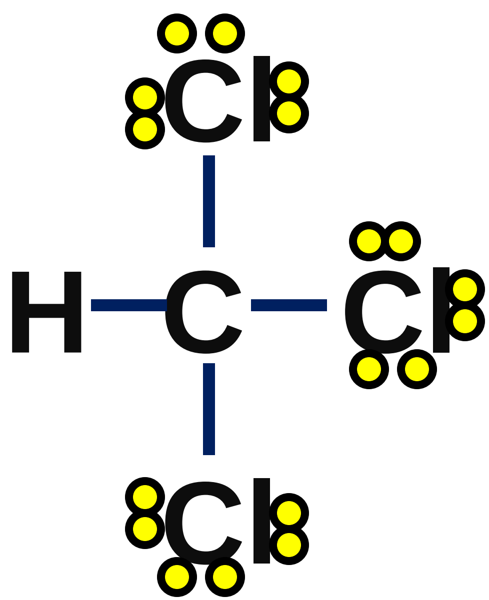
# of Ve^- = 4 + 1 + 3(7) = 26Ve^-

-8e^-

-18e^-

0Ve^-

C = central atom



We have used all the Ve- and every atom that needs and octet has one

Drawing Lewis Structures

Example: Draw the Lewis structure for PO_4^{3-}.

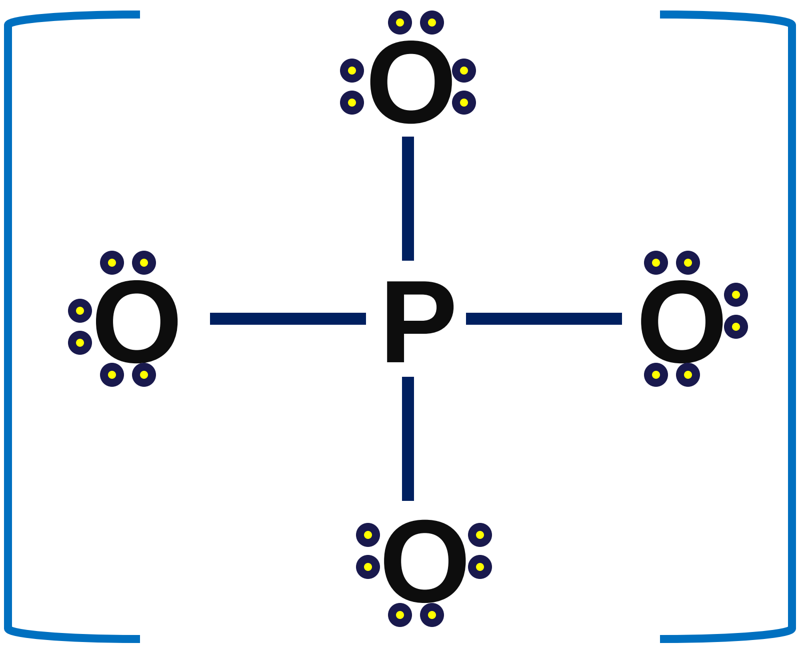
 # valence electrons = 5 + 4(6) + 3 = 32Ve^-

P = central atom

$-8e^-$

$-24e^-$

$-0Ve^-$



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Don't forget to show the charge of the ion, too.

Drawing Lewis Structure

With your partner write the steps for drawing Lewis structures. Note any special manipulations you may need to do to get all atoms an octet and use all your Ve^-.

1.

2.

3.

4.

Small Group Practice

In your lab groups please complete the Lewis structures of the following:

Carbon dioxide

Elemental iodine

CH_3Cl

Sulfate ion* **(remember the charge)**

Home Work

Read 322-323, #1-2 in text book

Bell Work19-Jan-2017

For the following compound and ions draw the Lewis structure using the four (4) steps:

1. Total number of Ve^-
2. Draw skeletal structure
3. Add e^- to outer elements
4. Add remaining e^- to central atoms, if you run out, use 2x or 3x bonds
5. Check that all Ve^- are used & that every atom that needs an octet has one, *add brackets w/ charge for ions, and draw all resonance structures.*

Cl_2 **CH_3Br**

SiO_2 **SO_4^{2-}**

Objective:

You will be able to draw resenance how to predict the molecular geometry and bond angles of simple compounds based on their Lewis Structure

EQ: What am I doing today for my future goals and how can keep on track.

Practice

Complete the following for SiO

#of Valence electrons :_____

# of lone pairs (electrons ••):______

#of bonding pairs (—): ______

Structure:

Si O

Drawing Lewis Structures
Your Turn

Draw the Lewis structure for PCl_3

Draw the Lewis structure for NO_2^-

Draw the Lewis structure for XeF_2

Drawing Lewis Structures
Ion practice

a) BH_2^-

b) SO_3^{2-}

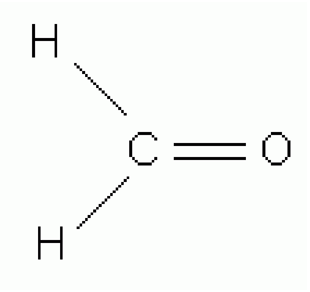
c) ClF_4^+ (Cl gets more than an octet)

d) ClO_3^-

Drawing Lewis Structures
Ion practice

Which is the correct structure for CH_2O?

1



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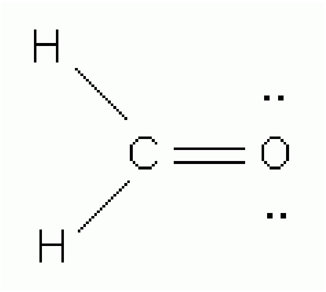

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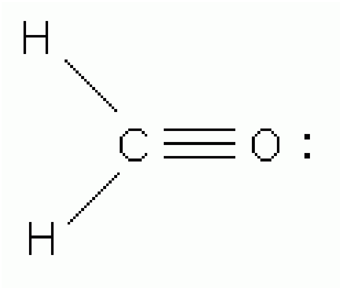

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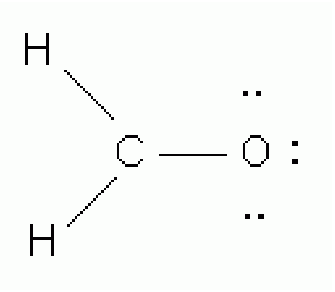


Drawing Lewis Structures

When writing the Lewis structure for ozone we could easily have put the double bond between the other two oxygens.

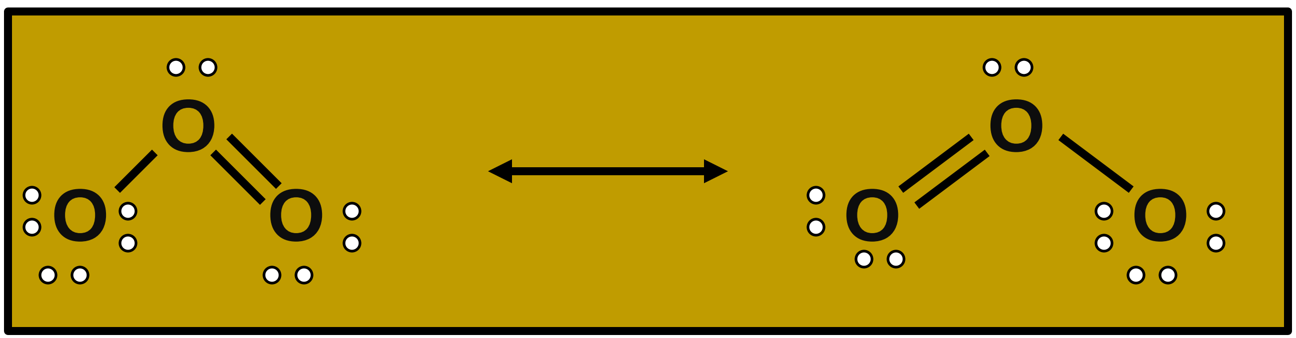
Ozone (O_3):

Drawing Lewis Structures

These two structures are equivalent except for the placement of electrons.

Resonance structures

Resonance structures for ozone:



Drawing Lewis Structures

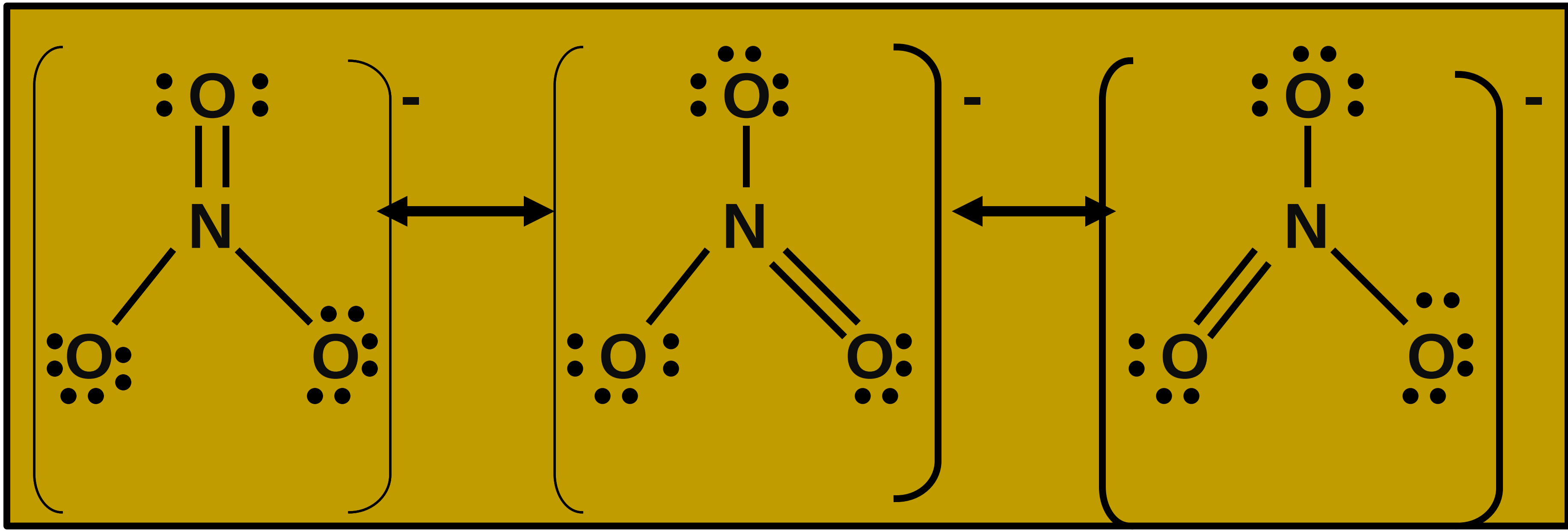
<u>Resonance structure:</u> one of a group of Lewis structures used to describe a molecule that cannot be accurately depicted using a single Lewis structure

NOTE: The real molecule is a "hybrid" or average of the resonance structures. It does not "flip" back and forth between the possible structures.

Drawing Lewis Structures

Example: Draw all possible resonance structures for NO_3^-.

 # valence electrons = 5 + 3(6) + 1 = 24



Home Work

Start/ Keep working of Science fair experimental design trial run or engineering designee prototyping, initial trials and prototypes need to be finished by 27 January 2017. You will have two (2) weeks to amend your experimental design/ procedures and complete all data collection.